

**AMENDMENTS TO THE CLAIMS**

1. (Currently Amended) A network system ~~including~~ comprising:  
a plurality of paths; and  
at least one cache server, ~~the at least one cache server comprising~~:
  - a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information,[[;]
  - a path calculating section for ~~obtaining~~ identifying a candidate path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, wherein the path calculating section identifies the candidate path as having a maximum remaining bandwidth of the plurality of the paths and identifies a link on the candidate path that has a minimum remaining bandwidth,[[;]] and
  - at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation by using the candidate path ~~obtained~~ identified by the path calculating section when the minimum remaining bandwidth is not smaller than a predetermined value.
2. (Canceled)
3. (Original) The network system according to claim 1, further comprising:

a router on which a path control protocol operates to exchange network path information and path load information,

wherein the QoS path information obtaining section obtains the network path information and the path load information in cooperation with the router.

4. (Currently Amended) A network system having a plurality of paths, the network system comprising:

a plurality of path-settable routers, each of which allows a requested path to be set up on a network; and

at least one cache server, the at least one cache server comprising:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information,[[;]]

a path calculating section for obtaining a candidate path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, wherein the path calculating section identifies the candidate path as having a maximum remaining bandwidth of the plurality of the paths, identifies a link on the candidate path having a minimum remaining bandwidth and determines whether the minimum remaining bandwidth is not smaller than a predetermined value,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which request at least one of the path-settable routers to set the candidate path obtained by the path calculating section and carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server

cooperating operation, by using the candidate path set by said at least one of the path-settable routers.

5. (Canceled)

6. (Original) The network system according to claim 4, wherein each of the path-settable routers operates a path control protocol to exchange network path information and path load information, and the QoS path information obtaining section obtains the network path information and the path load information in cooperation with at least one of the path-settable routers.

7. (Currently Amended) A network system comprising:  
a plurality of routers;  
at least one cache server; and  
at least one relay server,  
wherein each of the routers operates a path control protocol to exchange network path information and path load information,

wherein the at least one cache server comprises:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information in cooperation with at least one of the routers, and [[;]]

a relay control section for selecting at least one relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for instructing the selected at least one relay server about data to be relayed, wherein the relay control section selects the at least one relay

server needed for setting a relay path on which there exists no congestion portion, and when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the relay server near to the congestion portion stores the data and, when the congestion has been relieved, transfers the data to downstream, and

wherein the at least one relay server relays the data according to an instruction from the relay control section.

8. (Canceled)

9. (Canceled)

10. (Currently Amended) A network system comprising:

a plurality of routers;

at least one cache server; and

at least one relay server,

wherein each of the routers operates a path control protocol to exchange network path information and path load information,

wherein the at least one cache server comprises:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information in cooperation with at least one of the routers, and  
[[;]]

a relay control section for selecting at least one relay server and a path, which are suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server

cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section selecting the path as having a maximum remaining bandwidth of a plurality of paths by identifying a link on the selected path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value, the relay control section further and for instructing the selected at least one relay server about data to be relayed and to relay the data using the selected path, the at least one relay server relaying the data according to an instruction from the relay control section.

11. (Currently Amended) A network system comprising:  
 a plurality of path-settable routers;  
 at least one cache server; and  
 at least one relay server,  
 wherein each of the path-settable routers operates a path control protocol to exchange network path information and path load information and is allowed a requested path to be set on a network,

wherein said at least one cache server comprises:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information in cooperation with at least one of the path-settable routers,[[;]]

a relay control section for selecting at least one relay server and a path, which are suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for instructing the selected at least one relay server about data to be relayed,[[;]] wherein the relay control

section selects the at least one relay server needed for setting a relay path on which there exists no congestion portion, and wherein, when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the relay server near to the congestion portion stores the data and, when the congestion has been relieved, transfers the data to downstream, and

a path setting section for requesting the selected at least one relay server to relay the data using the selected path, wherein said at least one relay server relays the data according to an instruction from the relay control section.

12. (Canceled)

13. (Canceled)

14. (Original) A network system comprising:  
at least one priority controllable router capable of controlling a priority of transmitting a packet to a link, based on priority information added to the packet; and  
at least one cache server for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, wherein a priority given to a packet to be used for communications generated by at least one of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation is lower than a priority given to a packet to be used for communications generated by a cache operation.

15. (Original) The network system according to claim 14, wherein said at least one cache server comprises:

a priority providing section for providing a priority request source with a priority predetermined for each priority-request source, when a request for providing a priority occurs;

a priority information adding section for adding priority information showing a priority to a packet, when the priority and the packet to be transmitted to the network have been received; and

a cache operating section, a link prefetching control section, an automatic cache updating section, and a cache server cooperating section, which request the priority providing section to provide a priority when a transmission packet has occurred, and pass the transmission packet and the priority provided by the priority providing section to the priority information adding section.

16. (Original) The network system according to claim 15, further comprising:  
a QoS path information obtaining section for obtaining QoS path information including network path information and path load information,  
wherein the priority providing section determines a priority based on a priority-request source and QoS path information obtained by the QoS path information obtaining section, when a request for providing a priority has occurred.

17. (Currently Amended) A network system ~~having comprising:~~  
at least one priority controllable router ~~and at least one cache server~~, wherein said at least one priority controllable router provides priority information to a packet associated with a specific communication flow by identifying this communication flow, and controls a priority of transmitting a packet to a link based on the priority information provided to the packet[[],]; and ~~said~~

at least one cache server ~~comprises comprising:~~

a QoS path information obtaining section for obtaining QoS path information including network path information and path load information,[[;]]

a priority providing section for obtaining a priority variable for each link of the network suitable for carrying out an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section [[;]]

a router priority setting section for requesting the priority controllable router to set a priority to a specific communication flow, based on a result obtained by the priority providing section, wherein a priority set for a packet generated by at least one of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation is set lower than a priority for a packet to be used for communications generated by a cache operation, [[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation by using the path obtained by the priority controllable router.

18. (Currently Amended) A network system ~~having at least one cache server and comprising:~~

at least one priority controllable router, wherein said at least one priority controllable router controls a priority of transmitting a packet to a link based on priority information provided to the packet [[,]]; and

~~said at least one cache server comprises~~ comprising:



a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a path calculating section for obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for providing priority information lower than priority information of a packet to be used for communications generated by a cache operation, to a packet to be used for communications generated by the automatic cache updating operation, the link prefetching operation, or the cache server cooperating operation,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, using the path by the path calculating section and using the packet of the priority provided by the path calculating section.

19. (Currently Amended) A network system ~~having~~ comprising:

at least one priority controllable router ~~and at least one cache server~~, wherein said at least one priority controllable router provides priority information to a packet associated with a specific communication flow by identifying this communication flow, and controls a priority of transmitting a packet to a link based on the priority information provided to the packet[[,]]; and

~~said~~ at least one cache server ~~comprises~~ comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a path calculating section for obtaining a path suitable for carrying out an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for obtaining a priority variable for each link of the network suitable for carrying out the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation,[[;]]

a router priority setting section for requesting the priority controllable router to set a priority to a specific communication flow, based on a result obtained by the path calculating section,[[;]] wherein a priority set for a packet generated by at least one of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation is set lower than a priority for a packet to be used for communications generated by a cache operation, and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation.

20. (Currently Amended) A network system ~~having at least one cache server and comprising:~~

at least one router, wherein said at least one router is allowed to control a priority of transmitting a packet to a link, based on priority information provided to the packet, and to set a requested path on the network[[,]]; and

~~said at least one cache server comprises comprising:~~

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a path calculating section for obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for providing priority information lower than priority information of a packet to be used for communications generated by a cache operation, to a packet to be used for communications generated by the automatic cache updating operation, the link prefetching operation, or the cache server cooperating operation,[[;]]

a path setting section for requesting the router to set a the path obtained by the path calculating section,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by using the packet of the priority provided by the path calculating section.

21. (Currently Amended) A network system ~~having at least one cache server and~~ comprising:

at least one router, wherein said at least one router provides priority information to a packet associated with a specific communication flow by identifying this communication flow, controls a priority of transmitting a packet to a link based on the priority information provided to the packet, and sets a requested path on the network[[,]]; and

~~said at least one cache server comprises~~ comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a path calculating section for obtaining a path suitable for carrying out an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, ~~and~~ for obtaining a priority variable for each link of the network suitable for carrying out the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, and for providing priority information lower than priority information of a packet to be used for communications generated by a cache operation,[[;]]

a router priority setting section for requesting a router to set a priority to a specific communication flow, based on a result obtained by the path calculating section,[[;]]

a path setting section for requesting the router to set a the path obtained by the path calculating section,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by using the path set by the router.

22. (Currently Amended) A network system ~~having at least one cache server, at least one relay server, and comprising:~~

at least one router, wherein said at least one router controls a priority of transmitting a packet to a link, based on priority information provided to the packet[[,]]; at least one relay server; and

~~said~~ at least one cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a relay control section for selecting one of said at least one a relay servers suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, instructing the selected relay server about data to be relayed, and providing priority information lower than priority information of a packet to be used for communications generated by a cache operation, to a packet to be used for communications generated by the automatic cache updating operation, the link prefetching operation, or the cache server cooperating operation,[[; and]]

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by using the packet of the priority provided by the relay control section, and

wherein the relay server relays the data according to an instruction received from the relay control section.

23. (Currently Amended) A network system ~~having at least one cache server, at least one relay server, and~~ comprising:

at least one router, wherein said at least one router provides priority information to a packet associated with a specific communication flow by identifying this communication flow, and controls a priority of transmitting a packet to a link based on the priority information provided to the packet;

at least one relay server; and

~~said~~-at least one cache server ~~comprises~~-comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information;

a relay control section for selecting one of said at least one a relay servers suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, for instructing the selected relay server about data to be relayed, and for obtaining a priority variable for each link of the network suitable for carrying out an automatic cache updating operation, a link prefetching operation, or a cache server cooperating operation, and for providing priority information lower than priority information of a packet to be used for communications generated by a cache operation,[[;]]

a router priority setting section for requesting one of said at least one a routers to set a priority of a specific communication flow, based on a result obtained by the relay control section,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by using the packet of the priority provided by the relay control section, and wherein said at least one relay server relays the data according to an instruction received from the relay control section.

24. (Currently Amended) A network system ~~having at least one cache server, at least one relay server, and comprising~~:

at least one router, wherein said at least one router controls a priority of transmitting a packet to a link, based on priority information provided to the packet[[,]];

at least one relay server; and

~~said at least one cache server comprises comprising:~~

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a relay control section for selecting a path and one of said at least one a relay servers, which are suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, for instructing the selected relay server about data to be relayed, for ~~and~~ instructing the selected relay server to relay the data using the selected path, and for providing priority information lower than priority information of a packet to be used for communications generated by a cache operation, to a packet to be used for communications generated by the automatic cache updating operation, the link prefetching operation, or the cache server cooperating operation,[[;]]and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by using the packet of the priority provided by the relay control section, ~~and~~ wherein said at least one relay server relays the data according to an instruction received from the relay control section

25. (Currently Amended) A network system ~~having at least one cache server, at least one relay server, and comprising:~~

at least one router, wherein said at least one router provides priority information to a packet associated with a specific communication flow by identifying this communication flow, and controls a priority of transmitting a packet to a link based on the priority information provided to the packet[[,]];

at least one relay server; and

~~said~~ at least one cache server ~~comprises~~comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a relay control section for selecting a path and one of said at least one a relay servers suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, for instructing the selected relay server about data to be relayed, instructing the selected relay server to relay the data using the selected path, ~~and~~ for obtaining a priority variable for each link of the network suitable for carrying out an automatic cache updating operation, a link prefetching operation, or a cache server cooperating operation, and for providing priority information lower than priority information of a packet to be used for communications generated by a cache operation,[[;]]

a router priority setting section for requesting the router to set a priority of a specific communication flow, based on a result obtained by the relay control section,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation



respectively, by using the packet of the priority provided by the relay control section, ~~and wherein~~ said at least one relay server relays the data according to an instruction received from the relay control section.

26. (Currently Amended) A network system ~~having at least one cache server, at least one relay server, and comprising:~~

at least one router, wherein said at least one router controls a priority of transmitting a packet to a link, based on priority information provided to the packet, and sets a requested path on the network[[,]]; ~~at least one relay server; and~~

~~at least one relay server; and~~

~~said at least one cache server comprises~~comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a relay control section for selecting a path and one of said at least one ~~a relay servers~~ suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, instructing the selected relay server about data to be relayed, and providing priority information lower than priority information of a packet to be used for communications generated by a cache operation, to a packet to be used for communications generated by the automatic cache updating operation, the link prefetching operation, or the cache server cooperating operation,[[;]]

a path setting section for requesting a router to set the path obtained by the relay control section,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out

respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by using the packet of the priority provided by the relay control section, ~~and wherein~~ said at least one relay server relays the data according to an instruction received from the relay control section.

27. (Currently Amended) A network system ~~having at least one cache server, at least one relay server, and comprising~~

at least one router, wherein said at least one router provides priority information to a packet relating to a specific communication flow by identifying this communication flow, controls a priority of transmitting a packet to a link based on the priority information provided to the packet, and sets a requested path on the network[[,]]; ~~at least one relay server; and~~

~~said at least one cache server comprises comprising:~~

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information,[[;]]

a relay control section for selecting a path and a relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, for instructing the selected relay server about data to be relayed, and for obtaining a priority variable for each link of the network suitable for carrying out an automatic cache updating operation, a link prefetching operation, or a cache server cooperating operation,[[;]]

a router priority setting section for requesting the router to set a priority of a specific communication flow, based on a result obtained by the relay control section, and for providing priority information lower than

priority information of a packet to be used for communications generated by a cache operation,[[;]]

a path setting section for requesting the router to set the candidate path ~~obtained~~ selected by the relay control section,[[;]] and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by using the packet of the priority provided by the relay control section, ~~and~~ wherein said at least one relay server relays the data according to an instruction of the relay control section.

28. (Currently Amended) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information;

a path calculating section for ~~obtaining~~ identifying a candidate path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the path calculating section identifying the candidate path having a maximum remaining bandwidth of a plurality of paths and determining a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by utilizing the candidate path ~~obtained~~ identified by the path calculating section.

29. (Currently Amended) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a path calculating section for ~~obtaining~~ identifying a candidate path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the path calculating section identifying the candidate path having a maximum remaining bandwidth of the plurality of the paths and determining a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section that requests the path-settable router to set the path obtained by the path calculating section, and carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by utilizing the candidate path set by the path-settable router.

30. (Currently Amended) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one router that operates a path control protocol to exchange network path information and path load information; and

a relay control section for selecting a relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache

server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section for identifying a candidate path having a maximum remaining bandwidth of a plurality of paths and identifying a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value, the relay control section further for and instructing the selected relay server about data to be relayed.

31. (Currently Amended) A cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a relay control section for selecting a candidate path and a relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section for identifying the candidate path having a maximum remaining bandwidth of a plurality of paths and identifying a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value, the relay control section further for and instructing the selected relay server about data to be relayed; and

a path setting section for requesting said at least one path-settable router to set the candidate path selected by the relay control section.

32. (Currently Amended) A cache server provided in a network system having a priority controllable router for controlling a priority of transmitting a packet to a link based on priority information provided to the packet, wherein

the cache server carries out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, and provides priority information to a packet to be used for communications generated by the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, wherein the priority information is lower than priority information of a packet to be used for communications generated by a cache operation.

33. (Original) The cache server according to Claim 32, further comprising:  
a priority providing section for providing a priority request source with a priority predetermined for each request source, when there has been a request for providing a priority;  
a priority information adding section for adding priority information showing the priority to a packet, when the packet to be transmitted to the network and the priority have been received; and  
a cache operating section, a link prefetching control section, an automatic cache updating section, and a cache server cooperating section, each of which requests the priority providing section to provide a priority when a transmission packet has been generated, and passes the priority provided by the priority providing section and the transmission packet to the priority information adding section.

34. (Currently Amended) A cache server on a network provided with at least one priority controllable router that provides priority information to a packet associated with a specific communication flow by identifying this communication flow, and controls a priority of transmitting a packet to a link based on the priority information provided to the packet, the cache server comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information;

a priority providing section for obtaining a priority variable for each link of the network suitable for carrying out an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section;

a router priority setting section for requesting at least one priority controllable router to set a priority to a specific communication flow, based on a result obtained by the priority providing section wherein the priority set is lower than a priority of a packet to be used for communications generated by a cache operation; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation respectively, by utilizing a path set by the priority controllable router.

35. (Currently Amended) A relay server for relaying data necessary for at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, according to an instruction received from a relay control section provided in a cache server, wherein the relay server identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value.

36. (Original) The relay server according to claim 35, wherein the relay server relays data for each content.

37. (Currently Amended) A router provided on a network, comprising:  
a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information; and

a relay control section for selecting a router having a relay function suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and for notifying the selected router of data to be relayed, wherein the relay control section identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value, and

wherein the QoS path information obtaining section and the relay control section are provided within a housing of the router, wherein the router relays the data according to an instruction received from a relay control section within another router.

38. (Currently Amended) A router provided on a network, allowing a requested path to be set on the network, the router comprising:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information;

a relay control section for selecting a candidate path and a router having a relay function suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, the relay control section for identifying a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value, and the relay control section for notifying a selected relay server of data to be relayed; and

a path setting section for requesting the router to set the candidate path selected identified by the relay control section,



wherein the QoS path information obtaining section, the relay control section and the path setting section are provided within a housing of the router, wherein the router relays the data according to an instruction received from a relay control section within another router.

39. (Currently Amended) A cache server controlling method comprising ~~the~~ steps of:

a) obtaining QoS path information that includes network path information and path load information;

b) obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the step (a) and by

b1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,

b2) identifying a link on the candidate path having a minimum remaining bandwidth, and

b3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

c) providing at least one of an automatic cache updating step, a link prefetching control step, and a cache server cooperating step, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by utilizing the path obtained at the step (b).

40. (Currently Amended) A cache server controlling method comprising ~~the~~ steps of:

a) obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path

control protocol to exchange network path information and path load information and sets a requested path on the network;

b) obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the step (a) by

b1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,

b2) identifying a link on the candidate path having a minimum remaining bandwidth, and

b3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value;

c) requesting at least one path-settable router to set the path obtained by the step (b); and

d) providing at least one of an automatic cache updating step, a link prefetching control step, and a cache server cooperating step, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by utilizing the path set by said at least one path-settable router.

41. (Currently Amended) A cache server controlling method comprising ~~the steps of:~~

a) obtaining QoS path information that includes network path information and path load information, in cooperation with at least one router that operates a path control protocol to exchange network path information and path load information;

b) selecting at least one relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the step (a)

c) obtaining a path suitable for carrying out the at least one of an automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by

c1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,

c2) identifying a link on the candidate path having a minimum remaining bandwidth, and

c3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

d)[[c)]] instructing said at least one selected relay server about data to be relayed.

42. (Currently Amended) A cache server controlling method comprising ~~the steps of:~~

a) obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

b) selecting at least one relay server and a path, which are suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the QoS path information obtaining step, and instructing said at least one selected relay server about data to be relayed, wherein the step of selecting the path further comprises

b1) identifying a candidate path having a maximum remaining bandwidth of a plurality of paths,

b2) identifying a link on the candidate path having a minimum remaining bandwidth, and

b3) determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

c) requesting said at least one path-settable router to set the path selected at the step (b).

43. (Currently Amended) A method for controlling a cache server provided on a network system having at least one priority controllable router capable of controlling a priority of transmitting a packet to a link based on priority information provided to the packet, the method comprising ~~the steps of~~:

- a) carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation; and
- b) providing priority information to a packet to be used for communications generated by the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, wherein the priority information is lower than priority information of a packet to be used for communications generated by a cache operation.

44. (Currently Amended) A method for controlling a cache server provided on a network system including at least one priority controllable router which provides priority information to a packet associated with a specific communication flow by identifying this communication flow and controls a priority of transmitting a packet to a link based on the priority information provided to the packet, the method comprising ~~the steps of~~:

- a) obtaining QoS path information that includes network path information and path load information;
- b) obtaining a priority variable for each link of the network suitable for carrying out an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained at the step (a);
- c) requesting at least one priority controllable router to set a priority, based on a result obtained at the step (b), wherein the at least one priority set is lower than a priority of a packet to be used for communications generated by a cache operation; and

d) providing at least one of an automatic cache updating step, a link prefetching control step, and a cache server cooperating step, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by utilizing a path set by the priority controllable router.

45. (Currently Amended) A recording medium storing a program for instructing a computer to function as:

a quality-of-service (QoS) path information obtaining section for obtaining QoS path information including network path information and path load information;

a path calculating section for obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, wherein the path calculating section identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation by using the path obtained by the path calculating section.

46. (Currently Amended) A recording medium storing a program for instructing a computer to function as:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a path calculating section for obtaining a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, wherein the path calculating section identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value; and

at least one of an automatic cache updating section, a link prefetching control section, and a cache server cooperating section, which request the path-settable router to set the path obtained by the path calculating section, and carry out respective ones of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation, by utilizing the path set by the path-settable router.

47. (Currently Amended) A recording medium storing a program for use in a computer of a cache server provided on a network system having at least one priority controllable router that controls a priority of transmitting a packet to a link based on priority information provided to the packet, the program instructing the computer to function as:

a priority providing section for providing a priority request source with a priority predetermined for each request source, when there has been a request for providing a priority;

a priority information adding section for adding priority information showing a priority to a packet, when the packet to be transmitted to the network and the priority have been received; and

a cache operating section, a link prefetching control section, an automatic cache updating section, and a cache server cooperating section, which request the priority providing section to provide a priority when a transmission packet has been generated, and pass the priority provided by the priority providing section and the transmission packet to

the priority information adding section, wherein a priority given to a packet to be used for communications generated by at least one of the automatic cache updating operation, the link prefetching operation, and the cache server cooperating operation is lower than a priority given to a packet to be used for communications generated by a cache operation.

48. (Currently Amended) A recording medium storing a program for instructing a computer to function as:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one router that operates a path control protocol to exchange network path information and path load information; and

a relay control section for selecting at least one relay server suitable for carrying out at least one of an automatic cache updating operation, a link prefetching operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and instructing said at least one relay server about data to be relayed, the relay control section further selecting a candidate path having a maximum remaining bandwidth of a plurality of paths, identifying a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value.

49. (Currently Amended) A recording medium storing a program for instructing a computer to function as:

a QoS path information obtaining section for obtaining QoS path information that includes network path information and path load information, in cooperation with at least one path-settable router that operates a path control protocol to exchange network path information and path load information and sets a requested path on the network;

a relay control section for selecting at least one relay server and a path suitable for carrying out at least one of an automatic cache updating operation, a link prefetching

operation, and a cache server cooperating operation, based on the QoS path information obtained by the QoS path information obtaining section, and instructing said at least one relay server about data to be relayed, the relay control section selecting the path by identifying candidate path having a maximum remaining bandwidth of a plurality of paths, identifying a link on the candidate path having a minimum remaining bandwidth, and determining whether the minimum remaining bandwidth is not smaller than a predetermined value; and

a path setting section for requesting at least one path-settable router to set the path selected by the relay control section.

50. (Original) The network system according to claim 22, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

51. (Currently Amended) The network system according to claim 50, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved ~~disappeared~~, the data is transferred to downstream from the congestion portion.

52. (Original) The network system according to claim 23, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

53. (Currently Amended) The network system according to claim 52, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist



upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved ~~disappeared~~, the data is transferred to downstream from the congestion portion.

54. (Original) The network system according to claim 24, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

55. (Currently Amended) The network system according to claim 54, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved ~~disappeared~~, the data is transferred to downstream from the congestion portion.

56. (Original) The network system according to claim 25, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

57. (Currently Amended) The network system according to claim 56, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved ~~disappeared~~, the data is transferred to downstream from the congestion portion.

58. (Original) The network system according to claim 26, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

59. (Currently Amended) The network system according to claim 58, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved ~~disappeared~~, the data is transferred to downstream from the congestion portion.

60. (Original) The network system according to claim 27, wherein the relay control section selects at least one relay server that is necessary for setting a relay path on which there exists no congestion portion.

61. (Currently Amended) The network system according to claim 60, wherein when it is not possible to set a relay path on which there exists no congestion portion, the data is relayed to a relay server near to a congestion portion among relay servers that exist upstream from the congestion portion, wherein the data is stored and, when the congestion has been relieved ~~disappeared~~, the data is transferred to downstream from the congestion portion.

62. (Currently Amended) A network system including a plurality of routers and at least one cache server, said at least one cache server comprising:

a network monitor for monitoring a network to obtain QoS path information including network path information and path load information;

a path calculator for calculating a path for use in a cache control operation that is at least one of an automatic cache updating operation, a link prefetching operation, and a

cache server cooperating operation, wherein the path calculator identifies a candidate path having a maximum remaining bandwidth of a plurality of paths and identifies a link on the candidate path having a minimum remaining bandwidth, and determines whether the minimum remaining bandwidth is not smaller than a predetermined value; and

a controller for performing said cache control operation through the path calculated by the path calculator.

63. (Original) The network system according to claim 62, wherein the controller comprises:

a relay controller for selecting at least one router as a relay router from the routers depending on the path calculated by the path calculator.

64. (Original) The network system according to claim 62, wherein said at least one cache server further comprises:

a priority controller for providing a first priority to a packet for use in a communication associated with the cache control operation, wherein the first priority is lower than a second priority provided to a communication associated with an ordinary operation of said at least one cache server.